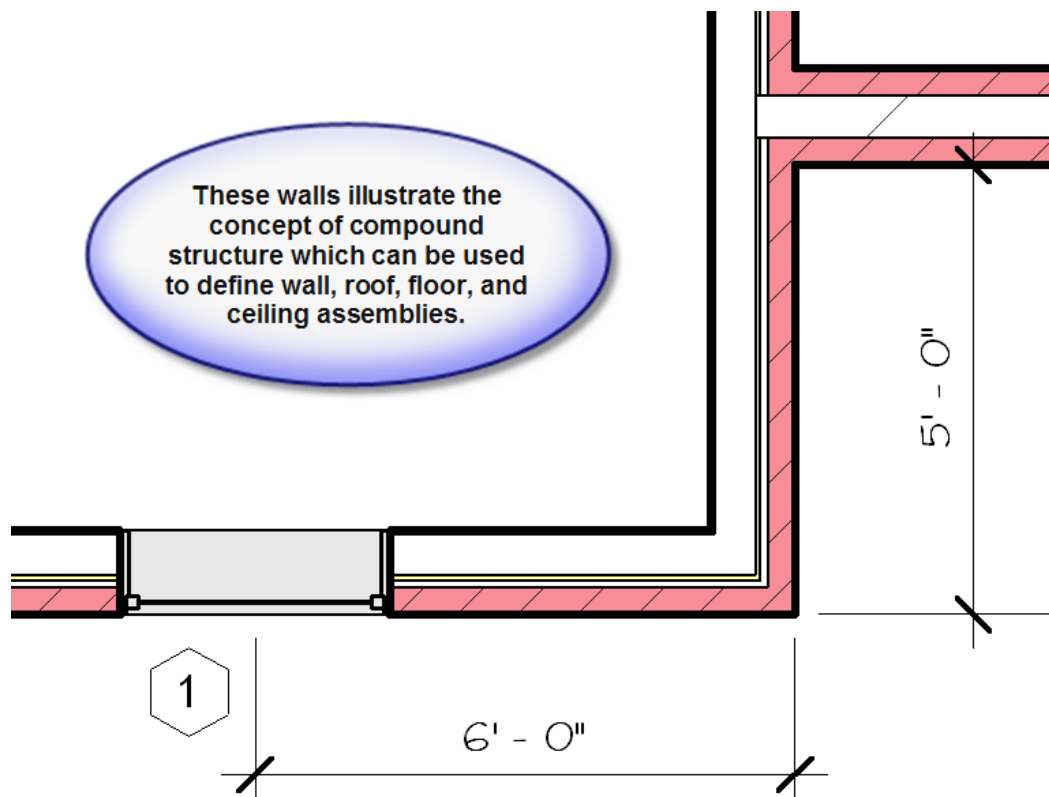


AGENDA:

1. Compound Structure and Custom Wall Types
2. Vertically Compound Walls

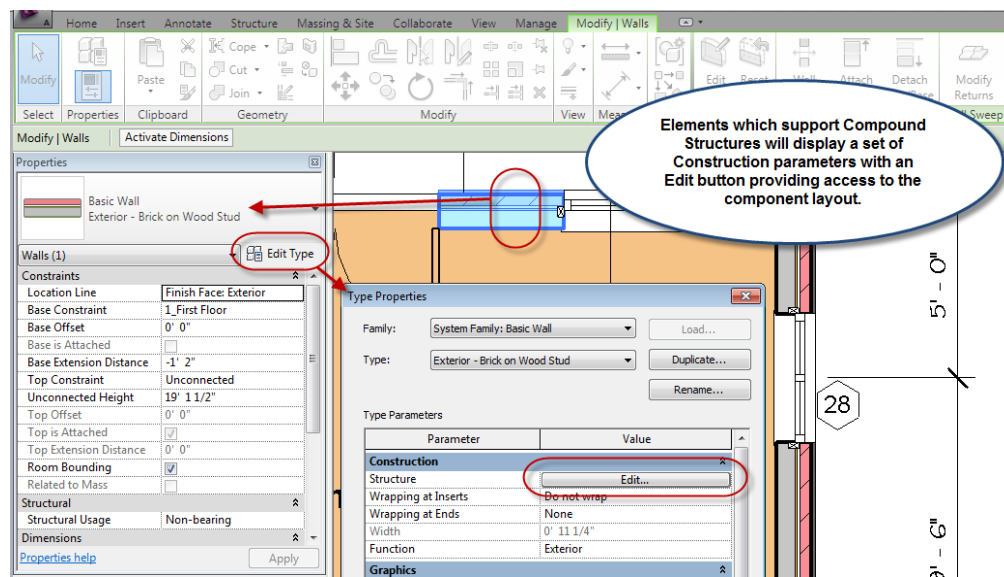
1. Compound Structure and Custom Wall Types

Many Revit elements are made up of a distinct structure of parallel layers which define components that will be required to build that element. Different layers in the structure are defined in terms of their function, thickness, and material designation.



Layers in a compound structure may have a continuous thickness as in the brick veneer in the walls shown above, a zero thickness for objects that have only a negligible thickness like vapor barriers, or their thickness may represent the overall zone in which objects are added as in the case of studs, joists or rafters. These elements only occupy space every foot or two but their overall space in the assembly still represents a layer with a thickness.

To access the structure makeup and settings for an element that supports compound structure, in the properties palette for the element, choose the Edit Type button and then in the Construction parameters section, pick Edit to open the Edit Assembly dialog where you modify the existing structure and delete or insert new layers.



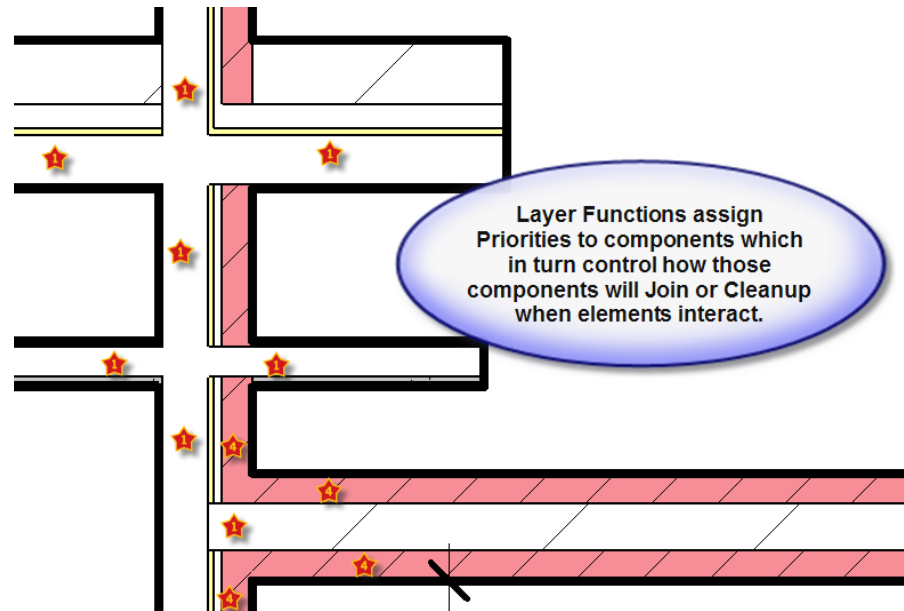
Each layer that makes up a compound structure sub category is usually assigned a material. If a material is not explicitly assigned for that layer, the material will be set to By Category. This means that the default material assigned to that category in the Object Styles dialog will be used.

The material is used not only to define the appearance of the layer but also to describe what comprises that layer. For example one layer might be used to define an empty air space in a brick veneer wall but that layer will still be assigned a material. The miscellaneous air layer material is a pure white color with no fill patterns. A wood flooring material, on the other hand, could be assigned to the $\frac{3}{4}$ " thick Finish Wood Floor layer in a floor assembly.

The materials in layers will display fill patterns in both cut and projection style views if those materials have fill patterns assigned. Material fill patterns only display when the view detail level is set to Medium or Fine. It is possible to have the same pattern or a different pattern and different color assigned to the Coarse Scale Fill Pattern field in the Type Properties dialog. Pattern and Color may be assigned in the Graphics category of parameters.

Each layer within a compound structure has a specific function assigned to it. These functions in turn define a priority which is used to control how layers join each other when two or more elements with a compound structure meet each other or cross each other.

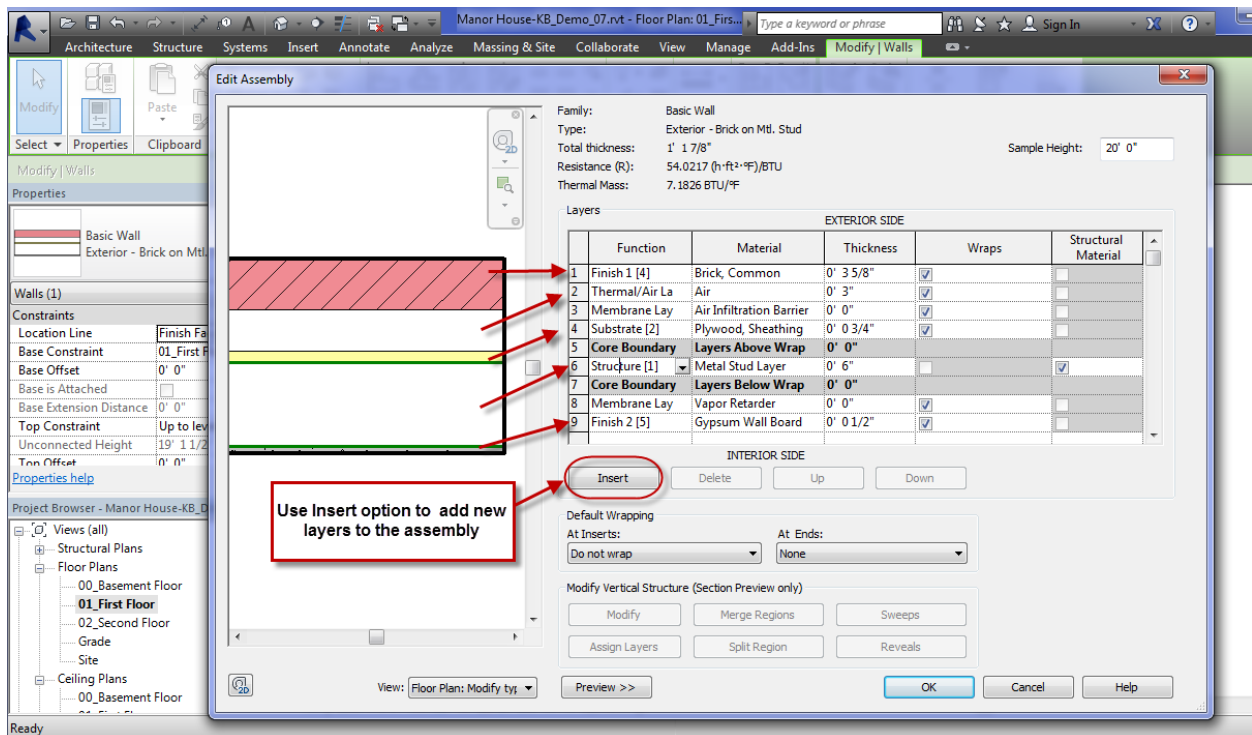
There are 5 layer functions each with an assigned priority. Higher priority components will cross or cut through lower priority components. Components with the same priority and the same material will clean up. If the function is the same but the material is different as in the case of a structural wood frame wall meeting a concrete block wall, a line appears between the joins.



The available functions which can be assigned to a layer are:

1. **Structure** (Priority 1) – This layer acts as the main support for the assembly such as a concrete block wall, floor joists, or rafters.
2. **Substrate** (Priority 2) – Substrate supports another material and is usually assigned to layers such as plywood sheathing or furring strips to support shingles or siding.
3. **Thermal/Air Layer** (Priority 3) - This layer is used for insulation or rain screen barriers.
4. **Membrane Layer** – This layer usually provides a barrier to moisture in liquid or vapor form. An example would be a layer of 6 mil polyethylene Air/Vapor barrier.
5. **Finish 1** (Priority 4) – The exterior finish layer such as bricks or shingles.
6. **Finish 2** (Priority 5) –The interior finish layer for gypsum wallboard typically.

Custom assemblies are defined by inserting new layers or modifying existing layers. You can make a wall or floor assembly from a simple generic wall with a single layer as a starting point but it is usually faster to look for a type that is already similar to what you need. You may need to just modify a single layer thickness or change a single material to obtain the desired wall type for your project.



Layer Wrapping settings allow you to specify how you want components in your assembly to be treated at open wall ends (end wrapping) and at openings such as doors and windows (insert wrapping). When you enable wrapping, the finish layers will wrap around the ends of the other layers, concealing them and showing only finish materials at that location.

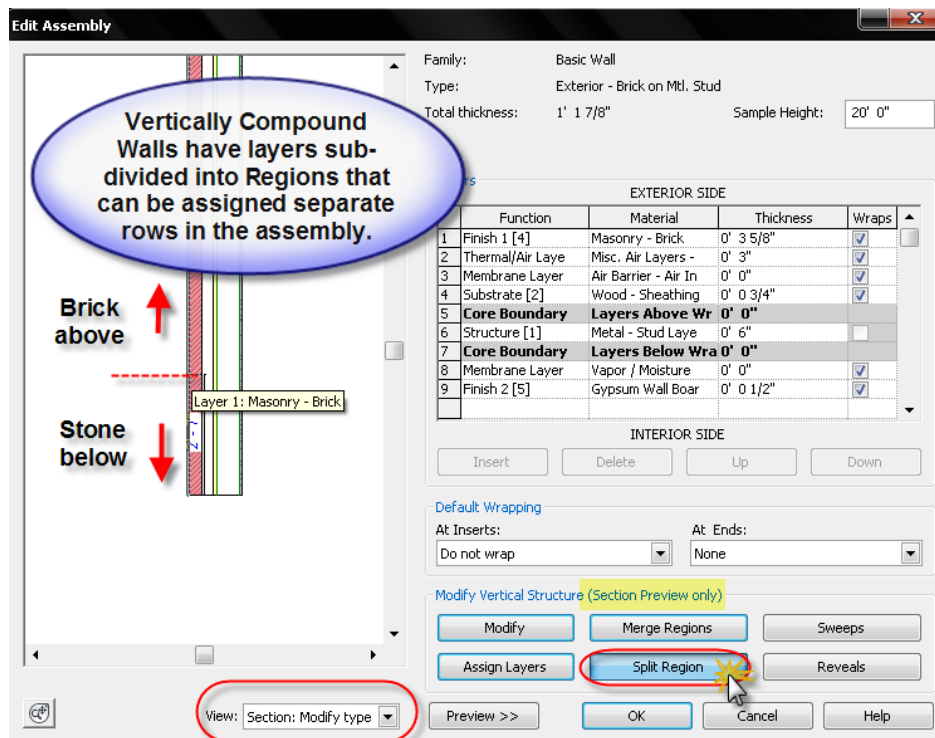
When you enable wrapping for Ends, you can choose the exterior components to wrap around the core to meet the interior finish, or the Interior components to wrap around the core and meet the exterior finish.

When you enable wrapping at inserts, you can choose Interior, Exterior, or you can have both finish components wrap at the same time.

2. Vertically Compound Walls

Compound Walls can be subdivided vertically, within the main structure, by defining vertical Regions and assigning Layers to those sub-regions within the main horizontal divisions of the wall.

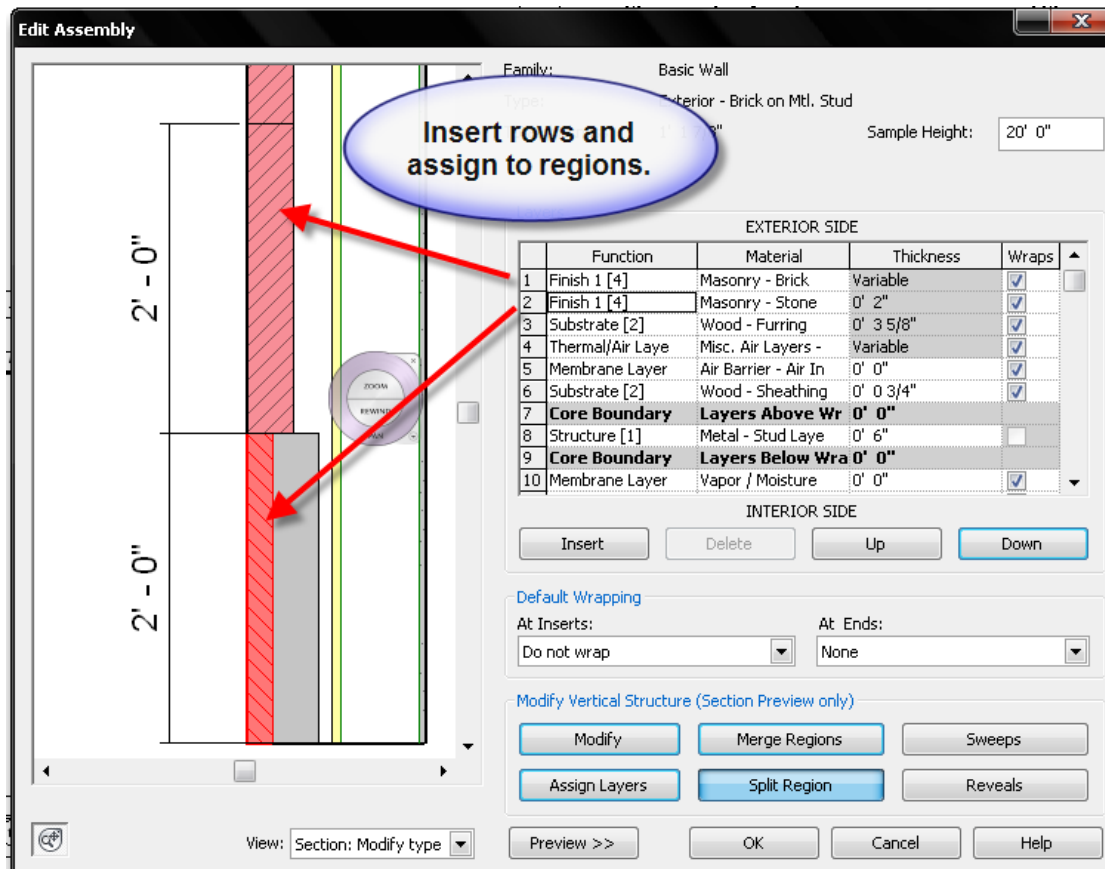
In a compound wall, each material component defined by a layer within that wall assembly, has a single thickness and the layer extends from the bottom to the top of the wall.



To subdivide a layer, set the view type to Section and use the Split Region tool to define a split location. If you zoom in a bit in the preview window, you can choose a point along one of the borders between layers and an edge will highlight, indicating which layer will be split.

After splitting a layer vertically, you have two resulting regions, each of which will be using the material and function of the original layer. To assign a new function and or material to one of the regions, Insert a new row into the assembly table, set the parameters for that row, and then with that row highlighted, pick the Assign Layers button and select the region to which you wish to assign the new row properties.

When you split a region vertically, a dimension will be shown in the preview window. To change the height of a region, pick the Modify button and then select the border between the two regions. This will highlight the dimension value and allow you to enter a new distance.

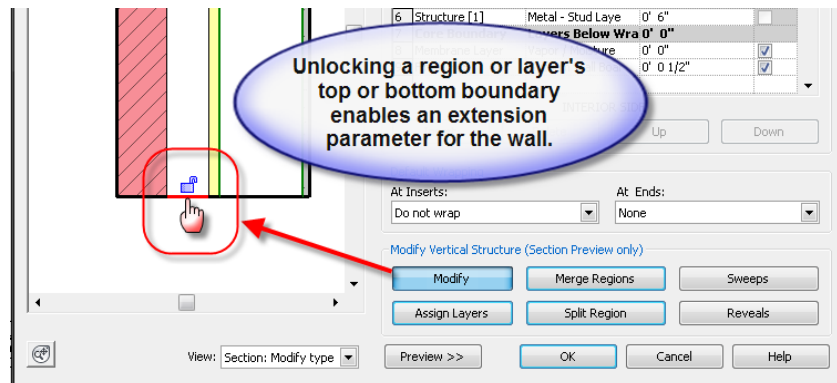


As you can see in the example above, the Split Region tool will also work to create vertical split lines in an existing layer or region. If you wanted to split an entire layer over the extents of the wall, just insert a new layer. If you want to split a region into two vertical sections, use the Split Region tool and pick a point along the horizontal border at the top or bottom of the regions. A temporary dimension will appear which you can use to set the width of the sub-region. The region width can also be set by dragging the internal border.

To reverse a split region, use the Merge region tool and move your cursor over the border between the two regions. A small rectangle and arrow icon will appear indicating which region properties will be assigned to the merged region.

When adjusting the width of a region, the overall width of the wall must remain constant. It is not possible to pull the outer face out of line with the face above. This is only possible by creating a Stacked Wall or through the use of Wall Sweeps. One other possibility would be to model the wall as In-place families. We will cover all of these methods in a future class.

It is possible to vary the heights of individual layers within the overall wall assembly relative to the top and bottom of the wall. If you choose the modify button and then pick a layer or region boundary at the top or bottom of the wall sample, it will enable

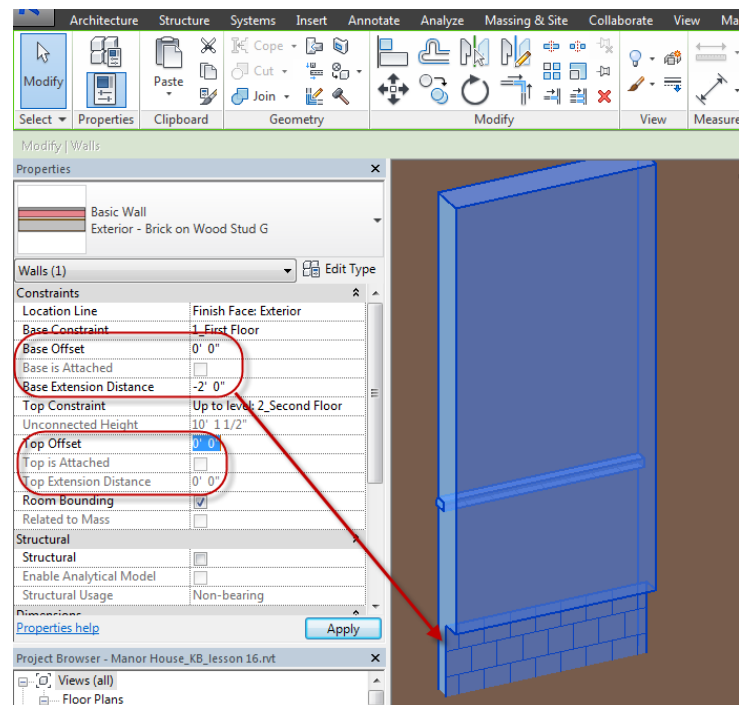


a layer extension value which will appear in the Instance parameters for the wall's element properties.

Top Extension parameters allow you to vary the height of one or more adjacent layers in the wall either above (positive distances) or below the default wall height set by the top constraint or unconnected height value. Bottom Extension parameters allow you to vary the height of adjacent wall layers above or below the base constraint for a selected wall.

Extensions will be applied relative to any offsets which will be evaluated for the top or bottom location for a wall. Base

offsets and Top offsets will adjust the height of all wall components above or below the default height or constraint location. Any extension distances will then be applied on top of the offset distance.



Exercise Notes

In the following exercises you will create a few custom wall types for your main project, assign new types to the exterior walls and then use others to add the interior walls for the first floor.

1. Open your Manor House project. All first floor exterior walls should be in place including all doors and windows. The exterior walls should be dimensioned but not locked. Try to keep the number of locks and constraints to a minimum.
2. Pick one of the main exterior walls, and in the Properties Palette, pick Edit Type and then Rename to change the name to Exterior – Brick on Wood Stud. In the structure field, choose the Edit Button to open the assembly editor.
3. In the view field below the Preview window, set the view type to Floor Plan. In the layer table at the right side, pick in the Thickness field for Layer 2, the air space, and reduce the thickness from 3" to 1". Pick in another field to update the preview window.
4. In the Core section, Layer 6, pick in the material field where it says Metal-Stud layer and then pick the Browse button to open the Material browser. In the Project Materials section in the upper left, choose the **Softwood Lumber** material and pick Ok. In the thickness field for the Wood layer, reduce the value to 5 ½". In Layer 4, set the Wood Sheathing thickness to 5/8". Pick Ok twice to close the dialog boxes and apply the changes. All of the exterior walls should have updated to reflect the new name and the new parameters for the custom wall type. Because we drew the walls with the location line set to the exterior face, the outer dimensions of the walls remain constant and the reduced thickness of the assembly is reflected in the larger interior spaces.
5. Switch to the default 3D view. Select bottom right corner of the View cube to switch to an isometric view from below the building and looking up at the bottoms of the walls. Zoom and pan your way into the left corner of the garage where you can see examples of inside as well as outside corners of the walls. This will afford a good view of the changes we'll make. If the view appears too dark change your visual style to Consistent Colors.

6. In this type of wall, the bottom of the wood studs and interior finish will be on top of a floor structure which will be supported on a foundation wall. The outer components of brick, air space, and sheathing will extend down in front of the floor assembly with the brick resting on the foundation. The sheathing will end slightly above that point to maintain proper transfer of loads through the framing system but we will include that detail in a drafting view. It is important to try to get the larger elements modeled correctly and then leave the minutiae to details and specifications.
7. Select one of the exterior walls and pick Element Properties. The Base Constraint is set to First Floor and the Base Offset is set to 0' 0". Try setting the Base offset to 2' 0" and pick OK. The wall base moves up 2 feet. Repeat and try the offset at negative 2' 0". The entire wall bottom is adjusted as one element. Hit CTRL-Z until the wall returns to its normal base, aligned with the other walls.
8. Pick the wall again, and type SA to select all instances. In the properties palette, pick Edit Type. Pick the Edit button by Structure. Change the View type to Section.
9. Place your cursor over the bottom of the wall and turn your mouse wheel to zoom in until the wall width fills the preview window and you can see the bottom edges of the wall. Pick Modify and then select the border under the brick layer to display its lock toggle. Unlock the element and then repeat for the two adjacent layers – air and sheathing. Pick OK twice to close the type properties.
10. In the Properties palette, set the Base extension distance to -1'2" and pick OK. After a brief pause the walls will redraw with the unlocked layers moved to the extension level. The inner face of the components extending below the base of the wall will show the same material as the exterior face. This is incorrect, as we should actually see the material for the plywood sheathing but it is a limitation of the software. This portion of the wall will be concealed by a floor system however so the appearance will not cause any problems.
11. Pick the wall again and open the element properties. Pick Edit/New and Edit again to open the assembly editor. Pick the material field for the gypsum wallboard and open the Material Browser. In the shading area pick in the color swatch area and then choose a paint color. I created an Antique White but any color you want to look at for the next while is fine. 😊 Pick Ok until you're back out to the model.

12. Pick the wall again and go back into the assembly editor. Zoom in around the lower section of the wall. Pick the Split Region tool and move your mouse over the brick layer. Pick a point approximately 2 feet above the base. Pick the Modify button and select the new border line at the top of the split region. Set the dimension to 2 feet.
13. Pick the top layer in the list of layers and pick Insert. Set the function of the new layer to Finish 1. Pick the material field and in the Material browser, look in the lower left section and under AEC Materials, choose the Stone Category. Pick the Limestone material and double-click to add it to the current document.
14. In the upper left section under Project materials, pick the new Limestone material. In the Graphics tab, in the surface pattern field, pick the empty swatch and set the fill pattern to Block 8x8. (use the Model Pattern Type option) Set the Cut Pattern to Diagonal Down. Pick Apply. Switch to the Identity tab, set the Class to Masonry, and then rename the material to Stone Veneer. Pick Apply.
15. *****Optional - To get a better appearance for the stone surface pattern, try creating a custom pattern by importing the supplied Castle Stone.pat file and setting the scale to 25.***
16. Pick the checkmark by Use Render Appearance for shading. Pick the Appearance tab to see what the material will look like in a realistic view. Pick the image swatch to open the Texture Editor. Increase the sample size width from 1'-10" to 4'-7" to better reflect the actual dimensions of the number of stones shown in the sample image. Pick Done to close the Texture Editor. Pick OK to close the material browser. Now for the tricky part. ☺
17. Pick on the new row in the list of layers. Pick the Assign Layers button. Pick the new region you create at the bottom of the wall until it highlights in blue and the hatch pattern changes. Pick the modify button and you should see a different color in the stone region. If it looks like brick still, repeat the process of picking the row, assign, and then the region.
18. Pick Modify again and then select the border at the bottom of the stone region. Unlock the border. Pick OK three times to close the dialogs and return to the drawing.
19. The two walls between the house and the garage are going to be a different construction and will have a single layer of brick on both sides of a 6" thick concrete block wall. Select the two walls and change their type to Exterior – Brick on CMU. Pick Edit Type on the properties palette. Rename the wall to Exterior-Brick on CMU – 2 sides. Pick edit to access the structure of the wall.

20. Highlight the second layer, for the 3" air space and pick Delete. Pick Delete twice more to delete the insulation and vapor barrier layers, leaving only the brick on the exterior side of the core. Pick the 5th layer, Metal furring and delete it. Pick the gypsum wall board material and in the Material dialog, select the Masonry Brick material. Increase the thickness of this layer to 3 5/8". Change the function from Finish 2 to Finish 1. Change the thickness of the masonry concrete layer to 5 5/8". Pick OK to close the dialogs.
21. The walls change configuration but if you look at them in 3D, you can see that they are above the other exterior wall bottoms. To get them to drop to the foundation level we can apply a base offset or simply change their base level constraint to T.O. Fndn level. Take the latter approach.
22. Edit the new wall style again and create a 3' 2" tall stone section at the bottom of each face of the wall. Use Split Region twice, Insert two new rows in the assembly table, set them to a finish function and a stone material and assign them to the new regions.
23. Switch to the Second Floor view. Before we add the interior walls we need to make a change in the upper left corner of the main building. In this corner the walls do not extend over two storeys, but are only a single storey in the laundry room. Zoom in to this area.
24. From the inside corner where the bay section at the back joins the horizontal wall on the left side start a wall with the exterior wall type. Access the element properties and confirm that the wall is constrained between the Second Floor and the 2nd Flr Clg levels and is not using any offsets or extensions. Draw the wall straight down six feet and then go left to meet the existing exterior wall.
25. Where the new, horizontal wall section meets the existing exterior wall, apply a trim command to create a clean corner. Select the short horizontal wall section at the top and access its element properties. Change the top constraint to 1st Flr Clg. Switch to the 3D view and get a look at the back corner of the building so you can see what you're doing so far.
26. Switch to the Floor 1 view and zoom into the corner we're working on. Pick the horizontal wall you just changed and choose create similar. Pick a point at the end of the vertical wall section and draw a wall up to meet the horizontal wall. It should clean up automatically but if not, use the Trim tool to clean the corner.

27. Switch back to a 3D view and checkout the inset corner on the second floor. The first floor walls will be covered with a roof in the next class so don't worry about the connection between the first and second floor where you may see a notch.
28. We don't need to see the stone portion of the exterior wall on the second floor in this area. Select the two, second floor walls, right-click and choose element properties. Pick Edit / New and Duplicate. Name the new style Exterior – Brick on Wood Stud 2. Edit the structure and use the Merge Region tool to merge the stone section with the brick section above. If you zoom in and float your mouse over the border between the two regions, a tooltip will appear letting you know which layer will be assigned after the merge. After you merge the regions, delete the stone layer in the assembly and pick OK.
29. After removing the stone portion, review the wall connections in both floor plan views. Switch to a 3D view and admire your handiwork. The garage walls are actually going to have a different condition at the bottom of the wall so we'll now adjust the garage walls. The same Wall type will work if we adjust the base constraint and extension. Float your mouse over one of the garage walls, press TAB and pick to select all of the walls around the garage. In the Properties palette, change the Base constraint to T.O. Fndn. and the Base Extension to zero. Pick Ok.
30. While we are working on the garage we should drop the level of the doors to T.O Fndn. Pick the door from the garage to the Porte Cochere and view its properties. Set the Level to T.O. Fndn and pick OK. Repeat for the garage doors but set them to Grade level.
31. We can now start adding the interior walls. First let's create a new wall type by duplicating an existing interior partition 4-7/8" wall type. Name the new wall type Interior – 4 1/2" Partition. Edit the structure and change the thickness of the stud layer to 3 1/2" and change the material to Wood – Stud layer. Change the thickness of the Gypsum wall board layers to 1/2" each bringing the overall thickness to 4 1/2" Pick OK and duplicate the wall type again.
32. Name the new wall type Interior – 6 1/2" Partition and edit the structure to change the thickness of the stud layer to 5 1/2". Pick Ok. In the Identity Data parameters, delete the Assembly code field. We will cover assembly codes in a future class. Pick Ok.

33. Start laying out the interior partitions for the first and second floors using the new wall types. If it is a main wall, use the 6 ½" partitions and for smaller walls use the 4 ½" partitions. When working on the second floor, use the underlay function to help align features between floors. Interior walls should align with the jogs in the exterior walls so you may want to start laying out the interior partitions at the exterior jog locations.
34. Add doors and any remaining windows in the main portion of the house. The windows in the guest suite over the garage will be added after we create the roof and extend the first floor exterior walls up to meet the roof.
35. *There may not be enough time to demonstrate the creation of all of the walls in the video demonstrations for this lesson. There is nothing new however in drawing walls, and adding a few doors. Use the dimensions on the handout drawings and your existing skills to complete the interior layouts. Feel free to make your own choices for door and window types but try to keep the locations the same as shown on the handout.*
36. Save and close the file and we will continue in the next lesson.

